

WHAT IS CLAIMED IS:

1. A bone fixation device, for securing a first bone fragment to a second bone fragment, comprising:

an elongate pin, having a proximal end and a distal end;

at least one radially advanceable anchor carried by the pin;

an actuator, axially moveable with respect to the pin; and

at least one retention structure in between the pin and the actuator, for permitting proximal movement of the pin with respect to the actuator but resisting distal movement of the pin with respect to the actuator;

wherein axial proximal movement of the pin with respect to the actuator causes at least a portion of the anchor to advance along a path which is inclined radially outwardly from the pin in the proximal direction.

2. A bone fixation device as in Claim 1, wherein the actuator comprises a tubular body axially slidably carried on the pin.

3. A bone fixation device as in Claim 2, wherein the anchor comprises at least one axially extending strip carried by the pin, the strip moveable from an axial orientation to an inclined orientation in response to axial proximal retraction of the pin.

4. A bone fixation device as in Claim 3, wherein the anchor comprises at least two axially extending strips.

5. A bone fixation device as in Claim 4, comprising four axially extending strips.

6. A bone fixation device as in Claim 3, wherein the strip has a proximal end and a distal end and the proximal end is free.

7. A bone fixation device as in Claim 6, further comprising a hub carried by the pin, and the distal end of the strip is connected to the hub.

8. A bone fixation device as in Claim 6, wherein the hub comprises an annular ring, axially movably carried by the pin.

9. A bone fixation device as in Claim 6, wherein the hub is fixed with respect to the pin.

10. A bone fixation device as in Claim 1, further comprising a first retention structure on the actuator for cooperating with a second retention structure on the pin to retain the device under compression.

11. A bone fixation device as in Claim 1, wherein at least one of the actuator and the pin comprise a bioabsorbable material.

12. A bone fixation device as in Claim 11, wherein the material is selected from the group consisting of poly (L,co-D,L-lactide).

5 13. A bone fixation device as in Claim 1, further comprising a tapered surface on the distal end of the actuator, so that proximal retraction of the pin with respect to the actuator causes the anchor to incline outwardly as it slides along the tapered surface.

10 14. A bone fixation device as in Claim 1, wherein the pin has a proximal end, a distal end, and an outside diameter, and the pin has a relatively larger diameter near the distal end and a relatively smaller diameter proximally of the distal end.

15 15. A bone fixation device as in Claim 11, wherein the anchor comprises a nonabsorbable material.

16 16. A bone fixation device for fixing two or more bone fragments, comprising:

an elongate tubular body, having a proximal end, a distal end and a longitudinal axis;

20 a distal anchor on the fixation device, moveable from an axial orientation for distal insertion through a bore in the bone to an inclined orientation to resist axial movement through the bore;

an elongate pin axially moveable within the tubular body and linked to the anchor such that proximal retraction of the pin with respect to the tubular body advances the distal anchor from the axial orientation to the inclined orientation.

25 17. A bone fixation device as in Claim 16, further comprising a retention structure for retaining the distal anchor in the inclined orientation.

18. A bone fixation device as in Claim 16, further comprising a proximal anchor.

30 19. A bone fixation device as in Claim 16, wherein the distal anchor comprises at least two axially extending strips spaced circumferentially apart around the tubular body.

20. A bone fixation device as in Claim 17, wherein the retention structure comprises at least one ramped surface that inclines radially inwardly in the proximal direction.

5 21. A bone fixation device as in Claim 17, wherein the retention structure comprises at least one annular ridge.

22. A bone fixation device as in Claim 16, further comprising a first retention structure on the tubular body, and a second, complimentary retention structure on the pin.

10 23. A bone fixation device as in Claim 16, wherein the tubular body comprises a first tapered surface and the pin comprises a second tapered surface such that proximal retraction of the pin with respect to the tubular body causes a radial enlargement of the tubular body.

24. A method of implanting a fixation device in a bone, comprising the steps of:

15                   advancing a fixation device into bone;  
                  proximally retracting a portion of the fixation device; and  
                  advancing at least one tine on the fixation device into bone in response to the proximally retracting step; the advancing step comprising advancing the tine along a path which inclines radially outwardly from an axis of the fixation  
20                   device in the proximal direction.

25. A method of implanting a fixation device as in Claim 24, wherein the advancing a fixation device step comprises advancing the fixation device through a predrilled bore.

25 26. A method of implanting a fixation device as in Claim 24, wherein the advancing a fixation device step comprises rotating the fixation device to drill a bore into the bone.

27. A method of implanting a fixation device as in Claim 24, further comprising the step of seating a proximal anchor against the bone prior to the proximally retracting step.

30 28. A method of implanting a fixation device as in Claim 24, comprising advancing at least four tines into bone.

29. A method of fixing a first bone fragment with respect to a second bone fragment, comprising the steps of:

advancing a fixation device through a first bone fragment and into a second bone fragment;

5 proximally retracting a portion of the fixation device; and

advancing at least one tine on the fixation device into the second bone fragment in response to the proximally retracting step; the advancing step comprising advancing the tine along a path which inclines radially outwardly at an angle from an axis of the fixation device in the proximal direction.

10 30. A method of fixing a first bone fragment with respect to a second bone fragment as in Claim 29, wherein the angle is within the range of from about 15 degrees to about 90 degrees.

15 31. A method of fixing a first bone fragment with respect to a second bone fragment as in Claim 30, wherein the angle is within the range of from about 30 degrees to about 60 degrees.

32. A method of fixing a first bone fragment with respect to a second bone fragment as in Claim 29, comprising advancing at least four tines into the second bone fragment.

20 33. A method of fixing a first bone fragment with respect to a second bone fragment as in Claim 29, wherein the first and second bone fragments are separated by a fracture..

34. A method of fixing a first bone fragment with respect to a second bone fragment as in Claim 33, wherein the fracture comprises a malleolar fracture.

25 35. A method of fixing a first bone fragment with respect to a second bone fragment as in Claim 33, wherein the fracture comprises a condylar fracture.

36. A method of fixing a first bone fragment with respect to a second bone fragment as in Claim 33, wherein the fracture comprises an epicondylar fracture.

37. A method of fixing a first bone fragment with respect to a second bone fragment as in Claim 33, wherein the fracture comprises a colles fracture.

30 38. A method of embedding a tine in cancellous bone, comprising the steps of:

providing a bone anchor having at least one tine thereon, the tine having an elongate body with a longitudinal axis, a proximal end, and a distal end, wherein the distal end is connected to the bone anchor and a leading edge is provided on the proximal end;

5                nonrotatably introducing the bone anchor into bone, with the longitudinal axis of the tine substantially parallel to a longitudinal axis of the bone anchor;

10              manipulating the proximal end of the bone anchor to drive the leading edge along a path which inclines radially outwardly from the longitudinal axis of the bone anchor, such that the tine lies along the path.